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Circularly Polarized Coaxial Feed Microstrip Patch Antenna

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***Abstract*— this paper presents a novel compact, single feed, rectangular circularly polarized, Micro strip antenna for RADAR communication, point to point and multipoint wireless communication. The proposed antenna fed by 50Ω impedance thin micro strip line occupies a compact volume of 34x34x0.508 mm3.Proposed design shows multiband characteristics for different center frequencies, and antenna offers a 2:1 VSWR bandwidth of 8.9%(10.047-10.906) at S11≤ -10 dB at center frequency of 10.2 GHz. Circular polarization is brought about by embedding a slit and by chamfering the diagonal edges of the patch. The software used for the simulation is the CST Microwave Studio which is an analytical tool that provides an accurate 3D EM simulation results for high frequency design.**

***Keywords**- Microstrip Antenna, VSWR, Circular polarization, Radar, Resonating frequency.*

I. INTRODUCTION

Micro strip antennas are attractive due to their light weight, conformability, low cost and ease of fabrication [1-3].These antennas can be integrated with printed strip -line feed networks and active devices. In its most fundamental form, a Micro strip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side. For a rectangular patch, the length of the patch is usually $0.3333\lambda_0 < L<0.5\ \lambda_{0,}$ where λ_0 is the free space wavelength. The patch is selected to be very thin such that t<< λ_0(where t is patch thickness).The height h of the dielectric substrate is usually $0.003 \leq h \leq 0.05\ \lambda_0$. The dielectric constant of the substrate(ε_r) is typically in the range $2.2 \leq \varepsilon_r \leq 12$[6].

Micro strip antenna radiates primarily because of the fringing fields between the patch edge and the ground plane. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation [6].However such a configuration leads to a larger antenna size. In order to design a compact Micro strip patch antenna, substrate with higher dielectric constants must be used which are less efficient and results in narrower bandwidth[5].Hence a trade-off must be realized between the antenna dimensions and antenna performance.

Proposed antenna used Micro strip line feed technique. The purpose of inset cut in the patch is to match the impedance of the feed line to the patch without the need for additional matching element. This is achieved by properly controlling the inset position[4].Patch antenna is analyzed using transmission line model .Hence this is an easy scheme ,since it provides ease of fabrication and simplicity in modeling as well as impedance matching. Circularly polarized single feed micro strip antenna is widely employed in RADAR, GPS and mobile communication systems. The advantage of single feed circularly polarized MSA is its simple structure due to absence of external polarizer.

II. ANTENNA GEOMETRY AND DESIGN

Geometry of the proposed antenna is illustrated in Fig.1. As shown initially, the dimensions of the slot are 34x34x0.508 mm^3. The inset recess dimensions are calculated [1] and length of the recess is 10.4 mm and width is 4 mm. In order to make it a circularly plagiarized antenna [7], two steps are taken First is to chamfer the diagonal edges with an angle =45 degree and taking W=L=3.3 is to cut a slit of length=9.7 mm and width =1 mm.

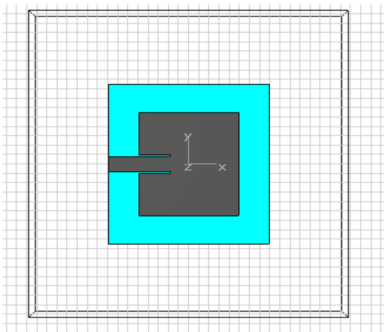

Figure 1. Geometry of the antenna (W=34mm, L=34mm, h=0.508, Ws=4, Ls=10.4, Wsl=1 mm, Lsl=9.7 mm)

Fig. 2 shows the surface current distribution of the proposed antenna for center frequency of 10.2 GHz**.**

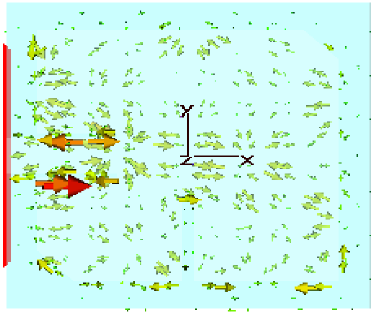

Figure 2. Surface current distribution of simulated antenna.

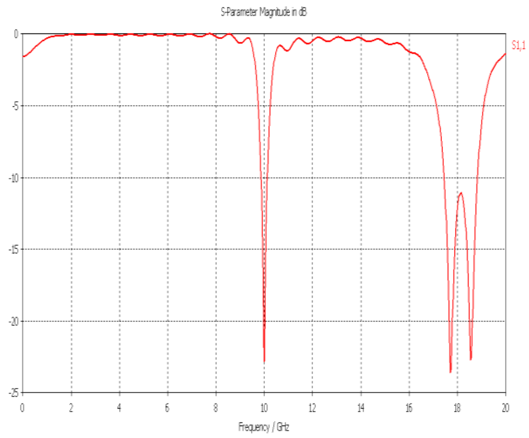

Figure 3. S11 parameters /Return loss of the multiband antenna

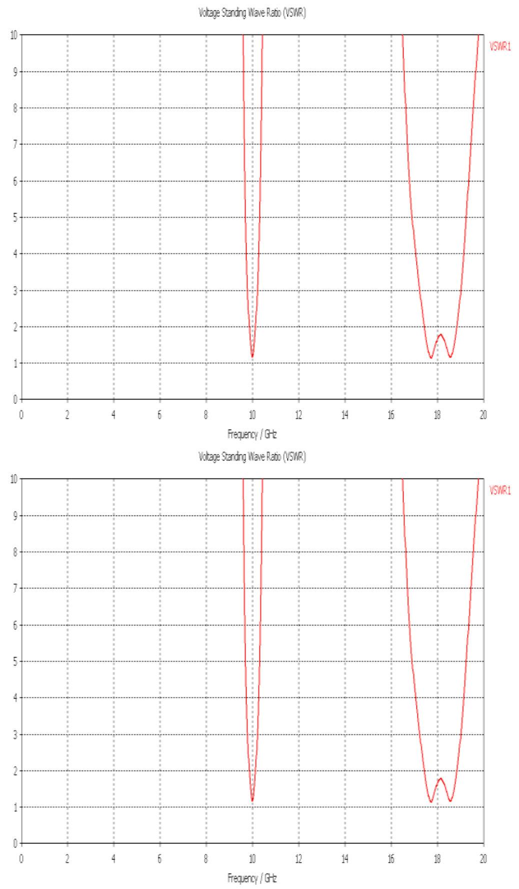

Figure 4. VSWR v/s FREQUENCY curve

As shown in Fig. 3 and 4, the antenna shows multiple frequency resonating nature.

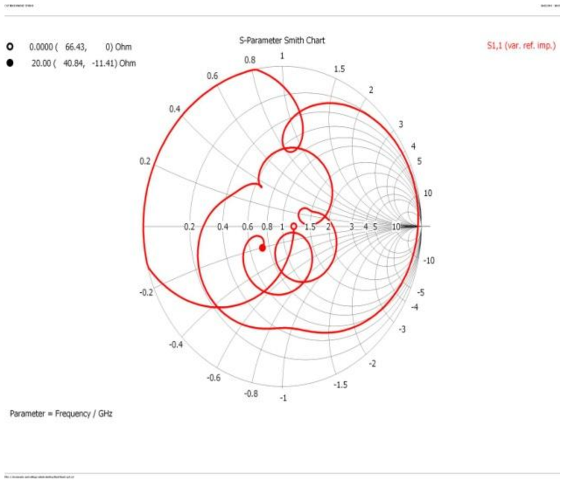

Figure 5. Smith Chart

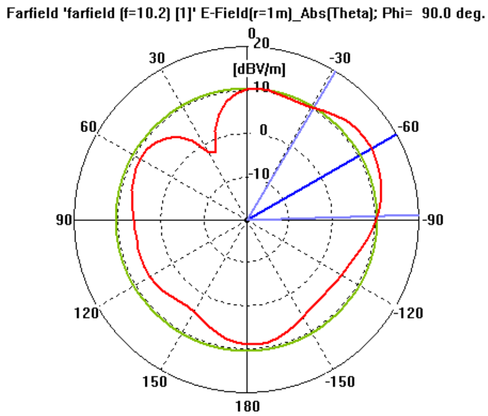

Figure 6. Electric field

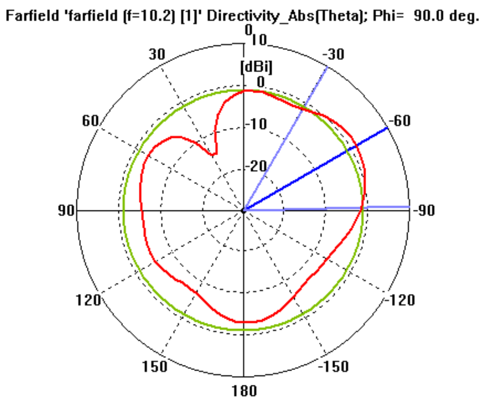

Figure 7. Directivity

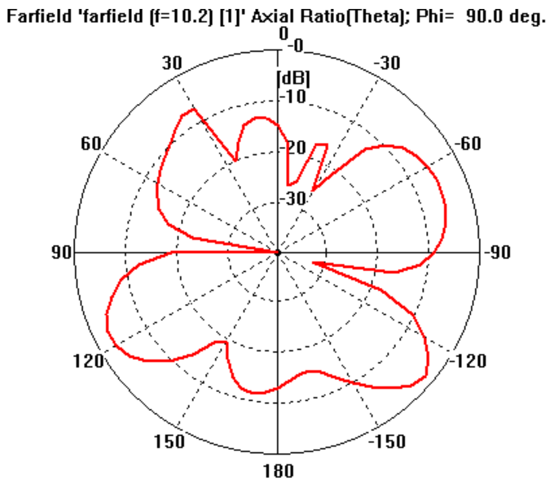

Figure 8. Axial Ratio

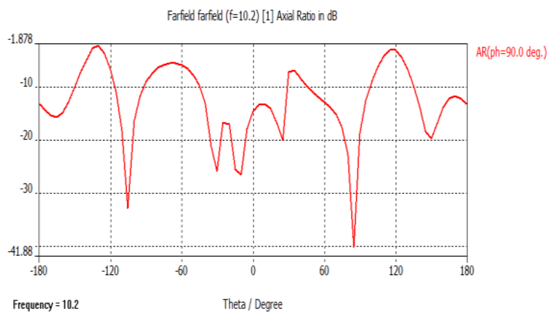

Figure 9. θ v/s Axial Ratio graph

Fig. 5, 6, and 7 shows the electrical characteristics of the antenna .fig. 8,9 shows the axial ratio v/s θ graph, which shows that the antenna has circular polarization.

III. RESULTS AND DISCUSSION

Proposed antenna is simulated by taking ε_r=2.2.Antenna is resonating for multiple frequencies ranging from 8.54-15.484 GHz.By taking S11≤- 10 dB and VSWR= 2:1 the bandwidth calculated for every resonating frequency comes out to be ≥ 2%. Data is tabulated in Table 1,which indicates all the resonating frequencies and their corresponding VSWR and S11.

TABLE I. RESONATING FREQUENCIES AND THEIR CORRESPONDING VSWR AND S11.

Sr. NO.	CENTER FREQUENCY	VSWR	S11(RETURN LOSS)
1.	8.54	1.57	-13
2.	10.2	1.133	-22
3.	11.944	1.2	-20
4.	13.604	1.154	-22
5.	14.523	1.243	-19
6.	15.484	1.018	-30

Table-1 is indicating all the resonating frequencies and their corresponding VSWR and S11.

IV. CONCLUSION

A novel design of single feed, circularly polarized, multiband, rectangular patch antenna has been successfully simulated. Best return loss is obtained at frequency15.484 (-30db) and the maximum BW available at the center frequency of 10.2 GHz is 8.9 %(10.047-10.906 GHz).Proposed antenna's multiband characteristics can be used for various RADAR related and wireless communication services.

REFERENCES

[1] K. Wong and W. Hsu, "A broadband patch antenna with wide slits," in IEEE Antennas and Propagation International Symposium, vol. 3, (Salt Lake City, Utah),pp. 1414– 1417, IEEE, July 2010.

[2] Chen, W.-L. and G.-M. Wang, \Small size edge-fed Sierpinski carpet microstrip patch antenna," *Progress In Electromagnetics Research C*, Vol. 3, 195{202, 2008.

[3] R. Garg, P. Bhartia, I. Bahl, and A. Ittipiboon, Microstrip Antenna Design Handbook, Artech House, 2000.

[4] K. F. Lee, Ed., "Advances in Microstrip and Printed Antennas," John Wiley, 1997.

[5] D. M. Pozar and D. H. Schaubert, Microstrip Antennas: The Analysis and Microstrip Antennas and Arrays, IEEE Press, 1995.

[6] Balanis, C. A., *Antenna Theory: Analysis and Design*, 811{862.